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Performance of Rice Straw Management and Nitrogen Scheduling on Yield and Growth Parameters of Summer Rice in Chhattisgarh Plain

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ABSTRACT

A field experiment was conducted in *Vertisols* at Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya. Raipur (Chhattisgarh) to study the performance of rice straw management and nitrogen scheduling on yield and growth parameters of summer rice in Chhattisgarh plain. Results indicated that incorporation of rice straw 5 t ha^{-1} by MB plough once + disc harrowing twice fb irrigation at 30 DBT (T_3) registered significantly highest grain and straw yields but it was at par to incorporation of rice straw 5 t ha^{-1} by + disc harrowing twice fb irrigation at 30 DBT (T_2). Its harvest index (%) is non-significant and plant height, number of tillers, dry matter accumulation, number of leaves hill^{-1} and LAI was recorded significantly higher under treatment incorporation of rice straw 5 t ha^{-1} by MB plough once + disc harrowing twice fb irrigation at 30 DBT (T_3) as compared to others. Although in number of tillers, dry matter accumulation, number of leaves hill^{-1} at par to treatments incorporation of rice straw 5 t ha^{-1} by + disc harrowing twice fb irrigation at 30 DBT (T_2) and normal transplanting (T_4) and along with in LAI was recorded at par to treatment incorporation of rice straw 5 t ha^{-1} by + disc harrowing twice fb irrigation at 30 DBT (T_2). However among nitrogen scheduling, treatment 20% B +20% 15 DAT + 30% AT + 30% PI (N_3) recorded significantly highest grain yield, straw yield and harvest index (%), plant height, number of tillers, dry matter accumulation, number of leaves hill^{-1} and LAI, but it was at par to 10% B +20% 15 DAT + 30% AT + 30% PI + 10% F (N_4), although in grain yield, straw yield, dry matter accumulation, number of leaves hill^{-1} and LAI and in harvest Index (%) recoded at par to treatment 30% B + 10% 15 DAT+ 30% AT + 30% PI (N_2) and 10% B +20% 15 DAT + 30% AT + 30% PI + 10% F (N_4).

Introduction

Rice (*Oryza sativa* L.) is stable food for millions of people in Asia pacific region. Ninety per cent of world's rice is grown and consumed in Asia. Chhattisgarh state is popularly known as "Rice bowl of India", which constitutes over 85% of the total food grain production in state. In *khaif*, rice is cultivated over an area of 3.68 m ha with productivity of 20.20 q ha^{-1}. In summer season, it is cultivated in 1.97 lakh ha area with productivity of 38.47 q ha^{-1} (Anonymous, 2015). Imbalanced nutrient management and decreased soil organic matter are the key responsible factors for the observed declining trend in rice-based cropping systems (Nambiar 1995; Reddy and Krishnaiah 1999). Field burning of straw is often the most cost effective technique for quick disposal of straw by the rice farmers. While burning, some nutrients like carbon and nitrogen are released and not returned to the field (Bakker *et al.,* 2013). Atmospheric pollutant emission, loss of nutrients, diminished soil biota, and reduced total N and C in the top soil layer are the major problems of rice straw burning. Hence, to avoid the soil nutrient losses and atmospheric pollution, in-situ incorporation of straw is the best option. In field after harvest rice straw have lower decomposition rate due to its higher C: N ratio (33) compared to cow dung and dhaincha (Chowdhury *et al.,* 2002) To overcome these problems, combine harvested paddy straw is incorporated along with additional N source, bio-mineralizer, cow dung slurry and its combinations to know the soil nutrient availability of succeeding rice crop field.

Management of crop residues has significant implications for soil physical and chemical properties and when handled correctly, they improve soil organic matter dynamics and nutrient cycling, thereby creating a most efficient system (Smith *et al.,* 1992). Although rice straw have several nutrient, such as 0.38-1.01% N, 0.01-0.12% P and 1.0-3.0% K (Ponnamperuma, 1984), they are known to produce phyto-toxic substances during their decomposition (Elliott *et al.,* 1981). To alleviate such problems, the rice straw materials under intensive decomposition in heap or pits with adequate moisture and suitable microbial inoculants could be used as organic manure (Gaur *et al.,* 1990) in rice field. Nitrogen scheduling/management is essential for rice cultivation as the nitrogen use efficiency is between the range of 40 to 60 percent, application of appropriate quantity of nitrogen at right time is perhaps the simplest agronomic solution for improving the use efficiency of nitrogen (Devi *et al.,* 2012). The scientific information on option for nitrogen management in rice cultivation needs to be workout for higher productivity and reducing nitrogen demand, which will be helpful to lower the cost of cultivation. The nitrogen is most limiting factors in rice production.

Materials and Methods

In order to performance of rice straw management and nitrogen scheduling on yield and growth parameter of summer rice in Chhattisgarh plain. A replicated field experiment was conducted during summer season of 2013-14 and 2014-15 at Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalay, Raipur (C.G.). The soil of the experimental area was '*Vertisols*' which is locally known as *'Kanhar'*. The soil was neutral in reaction and medium in fertility levels having low in N, medium in P and high in K. The experiment was laid out in strip plot design with three replications.

The treatments consisted of 4 rice straw management viz. burning of rice residue (T_1), incorporation of rice straw 5 t ha^{-1} by disc harrowing twice fb irrigation at 30 DBT (T_2), incorporation of rice straw 5 t ha^{-1} by MB plough once + disc harrowing twice fb irrigation at 30 DBT (T_3) and normal transplanting (T_4) and 4 nitrogen scheduling viz., 40% B+ 25% AT + 25% PI + 10% F (N_1), 30% B + 10% 15 DAT+ 30% AT + 30% PI (N_2), 20% B+ 20% 15 DAT + 30% AT + 30% PI (N_3) and 10% B + 20% 15DAT + 30% AT + 30% PI+ 10% F (N_4). Rice cultivar – MTU 1010 was transplanted on 31st January 2014 and 1st February 2015 and harvest in 3rd week of May in 2014 and 2015.

Results and Discussion

Growth parameters

The two year mean data presented in Table 1 revealed that treatment incorporation of rice straw 5 t ha^{-1} by MB plough once + disc harrowing twice fb irrigation at 30 DBT (T_3) observed significantly higher plant height as compared to others treatment, and regarding rice straw management in number of tillers, dry matter accumulation and number of leaves $hill^{-1}$ was recorded significantly higher under treatment incorporation of rice straw 5 t ha^{-1} by MB plough once + disc harrowing twice fb irrigation at 30 DBT (T_3) as compared to others, but it remained at par to treatments incorporation of rice straw 5 t ha^{-1} by + disc harrowing twice fb irrigation at 30 DBT (T_2) and normal transplanting (T_4). As revealed treatment incorporation of rice straw 5 t ha^{-1} by MB plough once + disc harrowing twice fb irrigation at 30 DBT (T_3) registered significantly higher LAI than others, it was at par to treatment incorporation of rice straw 5 t ha^{-1} by + disc harrowing twice fb irrigation at 30 DBT (T_2) on two year mean basis.

As regards to nitrogen scheduling significantly plant height and number of tillers was observed under treatment 20% B +20% 15 DAT + 30% AT + 30% PI (N_3) as compared to others and the lower value of treatment was 40% B+ 25% AT + 25% PI + 10% F (N_1) and the treatment 20% B +20% 15 DAT + 30% AT + 30% PI (N_3) registered significantly higher dry matter accumulation, number of leaves $hill^{-1}$ and LAI, but it was at par to treatments 10% B + 20% 15 DAT + 30% AT + 30% PI + 10% F (N_4) on two year mean basis.

Table.1 Growth parameters of summer rice as influenced by rice straw management and nitrogen scheduling on year two mean data

Treatment	Plant height (cm)	Number of tillers m^{-2}	Dry matter accumulation (g m^{-2})	Number of leaves $hill^{-1}$	Leaf area index (LAI)
	At harvest	At harvest	At harvest	At harvest	90 DAT
Rice straw management					
T_1	86.22	627.33	2160.63	27.76	5.81
T_2	90.68	667.47	2392.28	33.14	6.14
T_3	93.63	680.73	2471.18	35.48	6.21
T_4	87.58	668.85	2356.28	34.30	6.08
SEm±	0.84	7.97	39.75	1.13	0.02
CD (P=0.05)	2.89	27.59	137.55	3.91	0.07
Nitrogen scheduling					
N_1	85.84	623.27	2032.80	25.51	5.40
N_2	87.63	659.18	2393.33	30.15	5.95
N_3	94.80	696.82	2534.38	38.23	6.50
N_4	89.84	665.11	2419.86	36.79	6.39
SEm±	0.52	7.15	35.20	0.48	0.04
CD (P=0.0 5)	1.80	24.74	121.80	1.66	0.14

Table.2 Grain yield, straw yield and harvest index (%) of summer rice as influenced by rice straw management and nitrogen scheduling on year two mean data

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)
Rice straw management			
T_1	46.22	55.75	45.34
T_2	48.81	59.18	45.16
T_3	50.41	60.26	45.50
T_4	47.05	56.72	45.32
SEm±	0.77	0.70	0.29
CD (P=0.05)	2.66	2.41	NS
Nitrogen scheduling			
N_1	45.76	57.68	44.24
N_2	46.58	55.97	45.41
N_3	50.71	59.48	45.99
N_4	49.44	58.79	45.67
SEm±	1.04	0.70	0.25
CD (P=0.0 5)	3.61	2.41	0.85

Grain and straw yield

The two year mean data presented in Table 2 revealed that treatment incorporation of rice straw 5 t ha^{-1} by MB plough once + disc harrowing twice fb irrigation at 30 DBT (T_3) registered significantly higher grain and straw yield as compared to others, but it was at par to treatment incorporation of rice straw 5 t ha^{-1} by + disc harrowing twice fb irrigation at 30 DBT (T_2) on two years mean basis. This might be due to straw incorporation which saved considerable amounts of nitrogen, phosphorus, potassium and sulphur and organic matter which would otherwise lost by burning. This is in accordance with the finding of (Singh *et al.*, 2008). The harvest index did not differ significantly due to different rice straw management treatments on two year mean basis. Among nitrogen scheduling, treatment 20% B +20% 15 DAT + 30% AT + 30% PI (N_3) recorded significantly higher grain and straw yield as compared to others, but it was at par to 10% B +20% 15 DAT + 30% AT + 30% PI + 10% F (N_4). In harvest index was recorded significantly highest under treatment 20% B +20% 15 DAT + 30% AT + 30% PI (N_3) which was at par to treatment 30% B + 10% 15 DAT+ 30% AT + 30% PI (N_2) and 10% B +20% 15 DAT + 30% AT + 30% PI + 10% F (N_4) on mean basis. The higher yields in above treatments are the resultant of higher yield attributes recorded in these treatments. Similar results were reported by (Sharma and Agrawal, 2006). The lowest grain and straw yield was recorded under 40% B+ 25% AT + 25% PI + 10% F (N_1) treatment which might be due to the fact that major share of N were applied during the early growth stages, produced lower grain yield. This may be attributed to the failure to synchronize the N supply as per demand of the crop at all the major system of crop growth crucial for higher yields (Chaudhary *et al.*, 2013). Delayed application of N might be helpful in keeping the plant greener for long and thereby facilitating the higher production and translocation of photosynthetic towards economic parts (Dar *et al.*, 2000).

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